

Exhibit L

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF LOUISIANA
MONROE DIVISION**

THE STATE OF LOUISIANA,
By and through its Attorney General, JEFF
LANDRY,

THE STATE OF MONTANA,
By and through its Attorney General, AUSTIN
KNUDSEN,

THE STATE OF ARIZONA,
By and through its Attorney General, Mark
Brnovich, et al.,

PLAINTIFFS,

v.

XAVIER BECERRA, in his official capacity as
Secretary of Health and Human Services; et al.,

DEFENDANTS.

CIVIL ACTION NO. _____

DECLARATION OF DR. JAY BHATTACHARYA

I, Dr. Jayanta (“Jay”) Bhattacharya, provide the following Declaration:

1. I am a former Professor of Medicine and current Professor of Health Policy at Stanford University School of Medicine and a research associate at the National Bureau of Economic Research. I am also Director of Stanford’s Center for Demography and Economics of Health and Aging. I hold an M.D. and Ph.D. in Economics from Stanford University. I have published 154 scholarly articles in peer-reviewed journals in the fields of medicine, economics, health policy, epidemiology, demography, statistics, law, and public health, among others. My research has been cited in the peer-reviewed scientific literature more than 11,800 times.

2. I have dedicated my professional career to the analysis of health policy, including infectious disease epidemiology and policy, and the safety and efficacy of medical interventions.

3. I have not received any financial or other compensation to prepare this Declaration. Nor have I ever received any personal or research funding from any pharmaceutical company. In writing this, I am motivated by a commitment to public health, scientific principles, and objective truth.

4. I have no existing doctor-patient relationship with any of the Plaintiffs.

5. I have been asked to provide my opinion as to whether the CMS Interim Final Rule ignores critical scientific evidence and does not protect patients or workers.

6. In preparation for giving my opinion in this Declaration, I reviewed the following materials:

a. The White House’s “Path out of the Pandemic” plan,ⁱ

- b. CMS guidance related to COVID-19 Medicare/Medicaid reimbursement,
- c. Governor DeSantis' recent comments about federal coercion of healthcare providers, and
- d. The CMS Interim Final Rule.

7. The federal government successfully began pressuring private hospitals to implement mandatory vaccine policies as early as July 2021:ⁱⁱ

The President announced vaccination requirements for the federal government **in July and called on the private sector to do more to encourage vaccination** as well. Since that time, employers, schools, nursing homes, restaurants, hospitals, and cities in all 50 states have announced new vaccination requirements. **Since July, the share of job postings that require vaccination are up 90%.**

8. President Biden's multiple-point plan includes the following policy statement:ⁱⁱⁱ

The President's plan will reduce the number of unvaccinated Americans by **using regulatory powers and other actions** to substantially increase the number of Americans covered by vaccination requirements – **these requirements will become dominant in the workplace.**

9. The third bullet point on President Biden's "COVID-19 Action Plan" provides that private hospitals will be required to implement mandatory vaccine policies. This fact was evident in the caption:

Requiring COVID-19 Vaccinations for Over 17 Million Health Care Workers at Medicare and Medicaid Participating Hospitals and Other Health Care Settings

10. The explanation provided below that caption makes it clear that the federal government intends to use its coercive power of controlling CMS reimbursements to implement "a consistent standard across the country" regarding healthcare providers:

The Centers for Medicare & Medicaid Services (CMS) is taking action to require COVID-19 vaccinations for workers in most health care settings that receive Medicare or Medicaid reimbursement, including but not

limited to hospitals, dialysis facilities, ambulatory surgical settings, and home health agencies. This action builds on the vaccination requirement for nursing facilities recently announced by CMS, and will apply to nursing home staff as well as staff in hospitals and other CMS-regulated settings, including clinical staff, individuals providing services under arrangements, volunteers, and staff who are not involved in direct patient, resident, or client care. These requirements will apply to approximately 50,000 providers and cover a majority of health care workers across the country. Some facilities and states have begun to adopt hospital staff or health care sector vaccination mandates. **This action will create a consistent standard across the country**, while giving patients assurance of the vaccination status of those delivering care.

11. The Administration explicitly stated its policy on September 9, 2021, in a press release from CMS:^{iv}

The Biden-Harris Administration will require COVID-19 vaccination of staff within all Medicare and Medicaid-certified facilities to protect both them and patients from the virus and its more contagious Delta variant. Facilities across the country should make efforts now to get health care staff vaccinated to make sure they are in compliance when the rule takes effect.

12. The vast majority of large healthcare providers derive significant portions of their revenue from payments from CMS, which oversee both the Medicare and Medicaid programs at the Federal level. Medicare and Medicaid account for roughly half of all health spending for patient care in the U.S.^v The threat to cut off CMS reimbursements is a threat that hospitals must take very seriously. If the federal government follows through with the threat, these hospitals will be required to re-engineer their business plans at significant expense, including perhaps a decision to cut the care dramatically it provides to Medicare and Medicaid patients (a population primarily of elderly, disabled, and poor patients).

13. CMS exercises broad authority over private hospitals through its ability to dictate requirements for receiving Medicare/Medicaid reimbursements:

- a. Through its agency rulemaking authority, the federal government exercises authority over healthcare providers receiving Medicare/Medicaid funds, through

Conditions of Participation (“COPs”) and Conditions for Coverage (“CFCs”).^{vi}

These are the federal health and safety standards that health care organizations must satisfy to participate in and receive funding from the Medicare and Medicaid programs.

- b. Under Section 1861(e) of the Social Security Act, the secretary of the U.S. Department of Health and Human Services may adopt COPs deemed “necessary in the interest of the health and safety of the individuals who are furnished services in hospitals.”^{vii}
- c. Although typically CMS must use notice-and-comment rulemaking to modify COPs and CFCs, the agency can waive this process and adopt changes through interim final rules whenever it finds “good cause,” meaning that notice-and-comment rulemaking would be “impracticable, unnecessary, or contrary to the public interest.”^{viii}
- d. CMS has waived notice-and-comment rulemaking when amending health and safety standards in response to the COVID-19 pandemic.
- e. For example, in August 2020, CMS added new hospital COVID-19 data reporting requirements and critical access hospital COPs to support virus tracking, prevent spread, and protect the health and safety of patients.^{ix} CMS invoked a good-cause exception to notice-and-comment rulemaking, as well as the typical 30-day delay in a rule’s effective date, stating that “time is of the essence in controlling the spread of COVID-19” and that “universal resident and staff testing will assist public health officials in detecting outbreaks and saving lives.”
- f. More recently, in May 2021, CMS issued an interim final rule establishing new requirements for educating long-term-care (“LTC”) residents and staff about

COVID-19 vaccines.^x Again, CMS explained that these changes were “critically important” given the ongoing pandemic since it would be “impracticable and contrary to the public interest for [CMS] to undertake normal notice and comment rulemaking procedures” under the circumstances.^{xi} Moreover, the agency explained it could not “afford [a] sizable delay in effectuating this [change]” due to the ongoing crisis.

- g. COPs and CFCs are national in scope, making them a powerful federal tool to compel changes, even over the resistance of private employers. For instance, in 1965, federal officials required hospitals to desegregate to be eligible for Medicare reimbursement, leading more than 1,000 hospitals to integrate their medical staff in less than four months.^{xii}

14. I reviewed the video of Governor DeSantis’ press conference on October 21, 2021, in which the Governor stated that the federal government was coercing private businesses and healthcare providers to implement vaccine mandates:

We need to take action to protect Florida jobs. We have a situation now, unfortunately, in our country where we have a federal government that is very much trying to use the heavy hand of federal government to force these injections.

And then the medical CMS — where they’re threatening the Medicaid and Medicare funding — we’re going to exhaust every legal avenue that we have there.

15. From my knowledge of the important role that CMS plays in financing the care of Medicare and Medicaid patients in health care systems, I believe the Governor’s comments are current, as is his characterization of the stated policies of the Biden Administration.

16. In August, the President announced that “nursing homes must vaccinate their staffs against COVID-19 if they want to continue receiving federal funding.”^{xiii} This provided a signal to other healthcare providers of what the rules relating to them would look like.

Hospital Economics.

17. Hospitals derive revenue from treating individual patients. Even non-profit institutions cannot operate for an extended period if expenses exceed revenues. There is no rational profit-based incentive for hospitals to engage in broad public health campaigns alongside government actors unless they are paid or coerced into doing so.

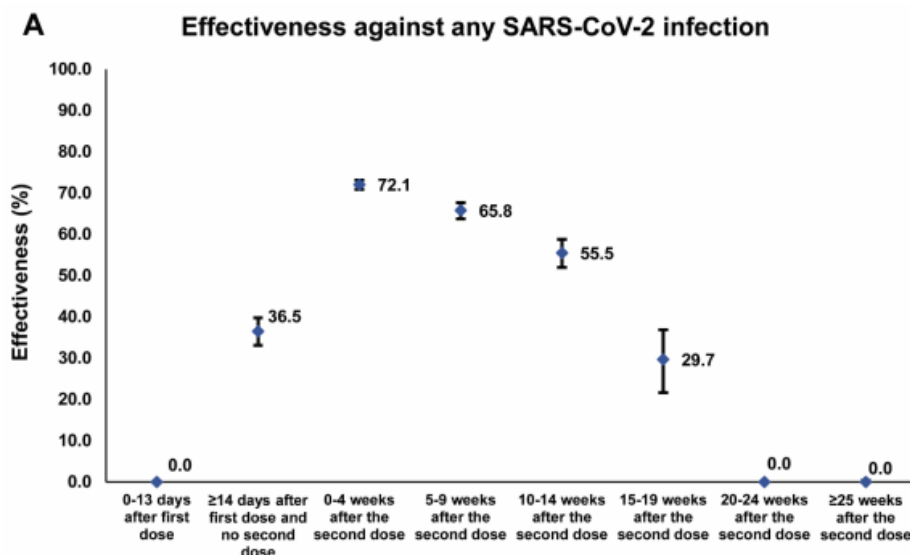
18. The CMS Interim Final Rule will create substantial internal economic dislocation by terminating the employment of substantial numbers of employees with a large amount of institutional knowledge (often referred to as job-specific human capital in economics) that cannot easily be replaced. The U.S., in general, is in the midst of a shortage of nurses, due in part to longstanding trends in the nursing profession^{xiv} and the pandemic-induced withdrawal of qualified workers from the labor supply.^{xv} It is irrational for facilities to terminate these employees, not least during an extended pandemic where the these facilities can profitably benefit from those employees’ services by treating COVID-19 patients and receiving federal reimbursements for doing so. Every lost employee hurts the hospitals’ bottom line.

19. In my opinion, the coercive federal threat of lost CMS reimbursements outweighs the cost of loss of experienced employees from a perspective focused on health care providers’ financial interests. However, such a narrow perspective does not account for the cost to society at large. Naturally, private organizations – even non-profit firms – are generally not empowered to make public policy decisions vested in governments. However, health care providers that enforce or enact COVID vaccine mandates are acting on behalf of the government, which is its using coercive economic means to compel private companies to institute public policy objectives.

20. While the hospitals may claim that their objectives are to protect workers and patients from COVID-19 infection, this is plainly inaccurate for two reasons. First, extensive scientific evidence indicates that vaccinated persons can become infected and thus still spread the virus. So vaccinating staff does not actually stop infection.

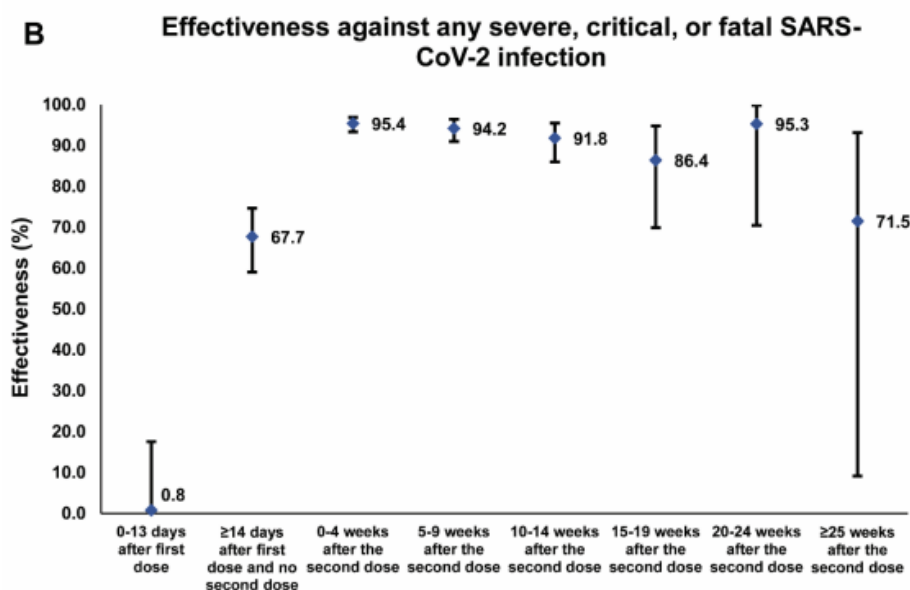
21. A recent study from Qatar by Chemaitelly and colleagues, which tracked 927,321 individuals for six months after vaccination concluded that the Pfizer vaccine's "induced protection against infection appears to wane rapidly after its peak right after the second dose, but it persists at a robust level against hospitalization and death for at least six months following the second dose."^{xvi}

22. The key figures from the Qatari study are reproduced immediately below. Panel A shows that vaccine mediated protection against infection peaks at 72.1% zero to four weeks after the second dose, and then declines to 0%, 20 weeks after the second dose. According to this result, vaccines only protect against infection (and therefore disease spread) for a short period of time after the second dose of the mRNA vaccines.

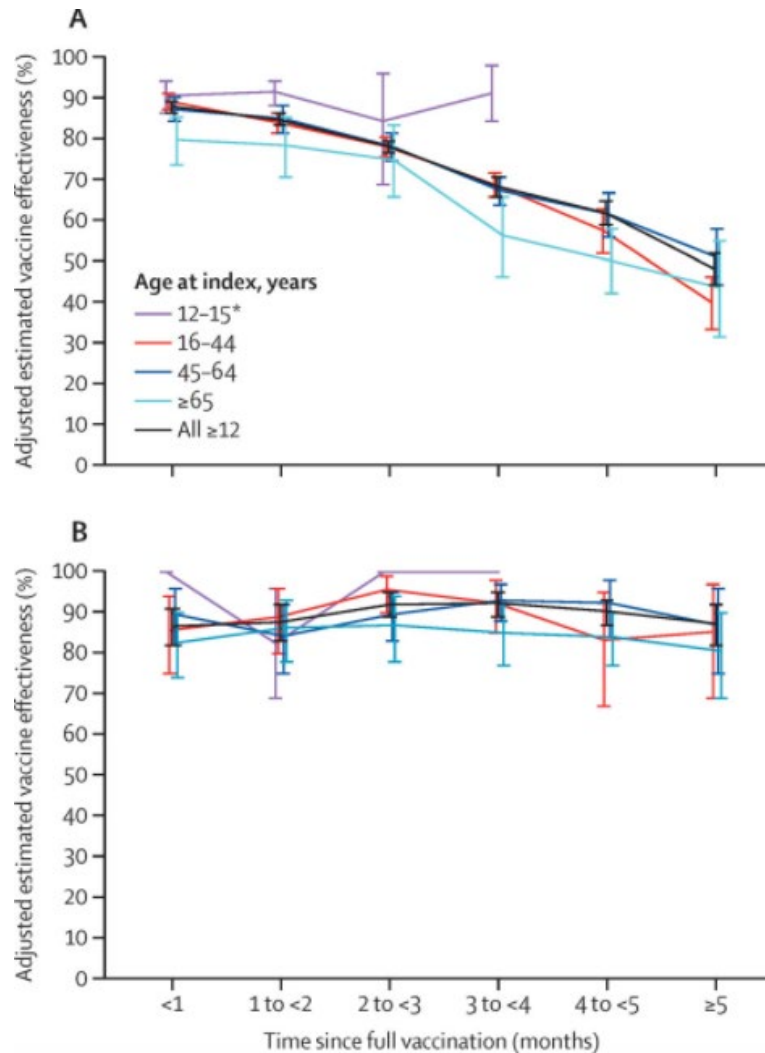


23. On the other hand, Panel B shows that protection versus severe disease is long lasting after vaccination—even though the person will no longer be fully protected against

infection and, presumably, disease spread. At 20-24 weeks after the second dose, the vaccine remains 95.3% efficacious versus severe disease. While it appears to dip after 25 weeks to 71.5% efficacy, the confidence interval is so wide that it is consistent with no decrease whatsoever even after 25 weeks.

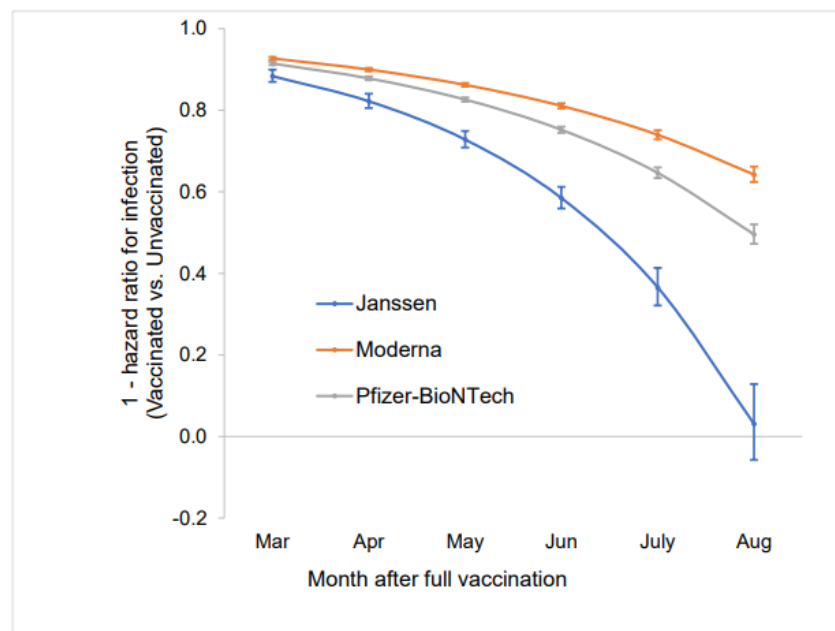


24. The Qatari study is no outlier. A large study in California tracked the infection rates for nearly 5 million patients vaccinated with two doses of the Pfizer mRNA vaccine. The study tracked both SARS-CoV-2 infections as well as COVID-19 related hospitalizations. The figure immediately below plots the trend in vaccine efficacy over time for different age groups in the population cohort. **Panel A** on the right plots effectiveness versus SARS-CoV-2 infections.^{xvii} Though



the drop in effectiveness is not as steep as in the Qatari study, there is nevertheless a sharp drop. While in the first month, vaccine effectiveness is near 90% for all age-groups, by month 5, it drops to nearly 50% for all the groups. By contrast, **Panel B** plots vaccine efficacy versus hospitalizations. It remains high with no decline over time –near 90% throughout the period. The vaccine provides durable private protection versus severe disease, but declining protection versus infection (and hence transmission).

25. Another recent study tracked 620,000 vaccinated U.S. veterans to measure breakthrough infections for the three vaccines in common use in the U.S.^{xviii} Like the other studies, the authors of the study found a sharp decline in vaccine effectiveness versus infection. Five months after vaccination, the effectiveness of the J&J vaccine dropped from ~90% to less than 10%; the Pfizer vaccine dropped from ~90% to ~50%; and the Moderna dropped from ~90% to ~65%. The figure on this page tracks the decline in effectiveness of the vaccines against infection over time documented in this study. This study corroborates yet another study that documented declining vaccine efficacy in the first three months after vaccination against disease transmission in the era of the Delta variant.^{xix}



26. Yet another study, conducted in Wisconsin, confirmed that vaccinated individuals can shed infectious SARS-CoV-2 viral particles.^{xx} The authors analyzed nasopharyngeal samples to check whether patients showed evidence of infectious viral particles. They found that

vaccinated individuals were at least as likely as unvaccinated individuals to be shedding live virus. They concluded:

Combined with other studies these data indicate that vaccinated and unvaccinated individuals infected with the Delta variant might transmit infection. Importantly, we show that infectious SARS-CoV-2 is frequently found even in vaccinated persons.

27. Additionally, the CMS Interim Final Rule evidences other indicia that it is not designed to protect patients and workers. In particular, the vaccine mandate policy makes no accommodation for the fact that COVID-recovered patients have strong protection versus infection, such that vaccination provides minimal benefit to them.

28. Immunologists have identified many immunological mechanisms of immune protection after recovery from infections. Studies have demonstrated prolonged immunity with respect to memory T and B cells,^{xxi} bone marrow plasma cells,^{xxii} spike-specific neutralizing antibodies,^{xxiii} and IgG+ memory B cells^{xxiv} following naturally acquired immunity.

29. Multiple extensive, peer-reviewed studies comparing natural and vaccine immunity have now been published. These studies overwhelmingly conclude that natural immunity provides equivalent or greater protection against severe infection than immunity generated by mRNA vaccines (Pfizer and Moderna).

30. Specifically, studies confirm the efficacy of natural immunity against reinfection of COVID-19^{xxv} and show that the vast majority of reinfections are less severe than first-time infections.^{xxvi} For example, an Israeli study of approximately 6.4 million individuals demonstrated that natural immunity provided equivalent if not better protection than vaccine immunity in preventing COVID-19 infection, morbidity, and mortality.^{xxvii} Of the 187,549 unvaccinated persons with natural immunity in the study, only 894 (0.48%) were reinfected; 38 (0.02%) were hospitalized, 16 (0.008%) were hospitalized with severe disease, and only one died,

an individual over 80 years of age. Another study analyzing data from Italy found that only 0.31% of COVID-recovered patients experienced a reinfection within a year after the initial infection.^{xxviii}

31. Variants do not escape the immunity provided by prior infection with the pre-variant virus or vaccination.^{xxix, xxx, xxxi} This is true of the delta variant as well. In a study of a large population of patients in Israel, *vaccinated* people who had not been previously infected were 13 times higher odds of experiencing a breakthrough infection with the Delta variant than patients who had recovered from COVID but were never vaccinated.^{xxxii} They had 27 times higher odds of experiencing subsequent symptomatic COVID disease and 7 times higher odds of hospitalization. The design of this Israeli study was particularly strong – it tracked large cohorts of people over time from the time of vaccination or initial infection and thus carefully distinguished the effect of time since initial exposure or vaccination in estimating its effect estimates. This is important because both vaccine-mediated and infection-mediated protection against subsequent infection diminish with time.

32. In summary, the overwhelming conclusion of the pertinent scientific literature is that natural immunity is at least as effective against subsequent reinfection as even the most effective vaccines.

33. Furthermore, based on such evidence, many scientists have concluded that natural protection against severe disease after COVID recovery is likely to be long-lasting. A survey article published on June 30, 2021, in the *British Medical Journal* concluded, “[t]here is reason to think that immunity could last for several months or a couple of years, at least, given what we know about other viruses and what we have seen so far in terms of antibodies in patients with COVID-19 and in people who have been vaccinated.”^{xxxiii}

34. These findings of highly durable natural immunity should not be surprising, as they hold for SARS-CoV-1 (the virus that causes SARS) and other respiratory viruses. According

to a paper published in *Nature* in August 2020, 23 patients who had recovered from SARS-CoV-1 still possess CD4 and CD8 T cells 17 years after infection during the 2003 epidemic.^{xxxiv} A *Nature* paper from 2008 found that 32 people born in 1915 or earlier still retained some level of immunity against the 1918 flu strain – some 90 years later.^{xxxv}

35. Indeed, the CDC recognizes the importance of natural immunity in its updated science brief analyzing the difference in immunity from infection-induced and vaccine-induced immunity.^{xxxvi} The CDC noted that “confirmed SARS-CoV-2 infection decreased risk of subsequent infection by 80–93% for at least 6–9 months,” with some studies showing “slightly higher protective effects (89–93%).” It also noted that “researchers have predicted that the immune response following infection would continue to provide at least 50% protection against reinfection for 1–2 years following initial infection with SARS-CoV-2 or vaccination. This would be similar to what is observed with seasonal coronaviruses.”

36. The CDC science brief does claim that vaccine-induced immunity is stronger than immunity from natural infection.^{xxxvii} This study the CDC relies on to support this claim is not determinative for several reasons.^{xxxviii} First, its result is contrary to the weight of other evidence, as set forth above. Second, the study compared hospitalization of those infected – and had natural immunity – 90–225 days after their infection while against those who had completed their RNA vaccine regime 45–213 days before reinfection. Because immunity – regardless of how gained – wanes over time, the failure to adequately compare like periods means that the study’s conclusions are biased in favor of vaccine-induced immunity. Indeed, the study admits this weakness. Third, the study design itself does not permit it to address the critical question of interest – whether COVID-recovery without vaccination or vaccination without COVID-recovery provides stronger protection against COVID-related hospitalization. The study analyzes only patients who are already in the hospital. To obtain an accurate answer to the question of interest,

it would need to include and analyze patients before entering the hospital. As it is, the study implicitly and incorrectly assumes that the set of hospitalized patients with COVID-like symptoms is representative of the population at large, which is untrue.

37. The fundamental principles of medical ethics should require that individuals who have recovered from COVID-19 should be exempt from any vaccine mandates and treated as in an identical position to those who have been vaccinated. Since the CMS has ignored these fundamental ethical principles, it is clear that any stated objective of vaccination to prevent infection is inaccurate.

38. The federal government is coercing the States to implement the vaccine mandate policy even though it contradicts fundamental ethical norms and threatens the stability of healthcare operations in America.

39. It is my opinion that the CMS Interim Final Rule ignores critical scientific evidence and does not protect patients or workers.

40. I am fully competent to make this declaration, and I have personal knowledge of the facts stated in this declaration. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on November 15, 2021.

/s/ Jay Bhattacharya, MD, Ph.D.

Dr. Jay Bhattacharya, MD, Ph.D.
Professor of Medicine
Stanford University

(original signature on file with counsel for Plaintiffs)

ⁱ <https://www.whitehouse.gov/covidplan/>.

ⁱⁱ Id. (emphasis added).

ⁱⁱⁱ Id. (emphasis added).

^{iv} <https://www.cms.gov/newsroom/press-releases/biden-harris-administration-expand-vaccination-requirements-health-care-settings>.

^v Bhattacharya J, Hyde T, Tu P. Health Economics, London: Palgrave-MacMillan, (2013).

^{vi} <https://www.cms.gov/Regulations-and-Guidance/Legislation/CFCsAndCoPs>.

^{vii} <https://www.law.cornell.edu/cfr/text/42/482.1> (“Hospitals participating in Medicare must meet certain specified requirements” and “The Secretary may impose additional requirements if they are found necessary in the interest of the health and safety of the individuals who are furnished services in hospitals”).

^{viii} <https://www.law.cornell.edu/uscode/text/5/553>;

<https://www.law.cornell.edu/uscode/text/42/1395hh>.

^{ix} <https://www.cms.gov/files/document/covid-ifc-3-8-25-20.pdf>.

^x <https://www.cms.gov/files/document/qso-21-19-nh.pdf>.

^{xi} <https://www.federalregister.gov/documents/2021/05/13/2021-10122/medicare-and-medicaid-programs-covid-19-vaccine-requirements-for-long-term-care-ltc-facilities-and>.

^{xii} <https://pubmed.ncbi.nlm.nih.gov/15757920/>.

^{xiii} <https://www.usatoday.com/story/news/politics/2021/08/18/biden-announce-nursing-homes-must-vaccinate-workers-against-covid-19/8183943002>.

^{xiv} Iacobucci W, Dall T, Chakrabarti R, et al. Florida Nurse Workforce Projections: 2019 to 2035. Florida Hospital Association and the Safety Net Hospital Alliance of Florida. July 27, 2021.

<https://documentcloud.adobe.com/link/track?uri=urn:aaid:scds:US:ac48ae7d-ff75-4a08-9a3d-cebbd0d08c27>

^{xv} Romero L and Bhatt J. Pandemic has made shortage of health care workers even worse, say experts. ABC News. May 21, 2021. <https://abcnews.go.com/US/pandemic-made-shortage-health-care-workers-worse-experts/story?id=77811713>

^{xvi} Chemaitelly, H., Tang, P., Hasan, M. R., Al Mukdad, S., Yassine, H. M., Benslimane, F. M., Khatib, H. A. A., Coyle, P., Ayoub, H. H., Kanaani, Z. A., Kuwari, E. A., Jeremijenko, A., Kaleeckal, A. H., Latif, A. N., Shaik, R. M., Rahim, H. F. A., Nasrallah, G. K., Kuwari, M. G. A., Romaini, H. E. A., Abu-Raddad, L. J. (2021). Waning of

BNT162b2 vaccine protection against SARS-CoV-2 infection in Qatar. *medRxiv*, Preprint. doi: 10.1101/2021.08.25.21262584

^{xvii} Tartof SY, Slezak JM, Fischer H, Hong V, Ackerson BK, Ranasinghe ON, Frankland TB, Ogun OA, Zamparo JM, Gray S, Valluri SR, Pan K, Angulo FJ, Jodar L, McLaughlin JM. Effectiveness of mRNA BNT162b2 COVID-19 vaccine up to 6 months in a large integrated health system in the USA: a retrospective cohort study. *Lancet*. 2021 Oct 16;398(10309):1407-1416. doi: 10.1016/S0140-6736(21)02183-8. Epub 2021 Oct 4. PMID: 34619098; PMCID: PMC8489881.

^{xviii} Cohn BA, Cirillo PM, Murphy CC, et al. Breakthrough SARS-CoV-2 Infections in 620,000 U.S. Veterans, February 1, 2021 to August 13, 2021. *medRxiv*. October 14, 2021. <https://doi.org/10.1101/2021.10.13.21264966>;

^{xix} Eyre, D. W., Taylor, D., Purver, M., Chapman, D., Fowler, T., Pouwels, K. B., Walker, A. S. & Peto, T. E. A. (2021). The impact of SARS-CoV-2 vaccination on Alpha & Delta variant transmission. *medRxiv*, Preprint. doi: 10.1101/2021.09.28.21264260

^{xx} Riemersma, K. K., Grogan, B. E., Kita-Yarbro, A., Halfmann, P. J., Segaloff, H. E., Kocharian, A., Florek, K. R., Westergaard, R., Bateman, A., Jeppson, G. E., Kawaoka, Y., O'Connor, D. H., Friedrich, T. C., & Grande, K. M. (2021). Shedding of infectious SARS-CoV-2 despite vaccination. *medRxiv*, Preprint. doi: 10.1101/2021.07.31.21261387

^{xxi} Dan, J. M., Mateus, J., Kato, Y., Hastie, K. M., Yu, E. D., Faliti, C. E., Grifoni, A., Ramirez, S. I., Haupt, S., Frazier, A., Nakao, C., Rayaprolu, V., Rawlings, S. A., Peters, B., Krammer, F., Simon, V., Saphire, E. O., Smith, D. M., Weiskopf, D., Crotty, S. (2021). Immunological memory to SARS-CoV-2 assessed for up to 8 months after infection. *Science*, 371, 1-13. doi: 10.1126/science.abf4063 (finding that memory T and B cells were present up to eight months after infection, noting that “durable immunity against secondary COVID-19 disease is a possibility in most individuals”).

^{xxii} Turner, J. S., Kim, W., Kalaidina, E., Goss, C. W., Rauseo, A. M., Schmitz, A. J., Hansen, L., Haile, A., Klebert, M. K., Pusic, I., O'Halloran, J. A., Presti, R. M. & Ellebedy, A. H. (2021). SARS-CoV-2 infection induces long-lived bone marrow plasma cells in humans. *Nature*, 595(7867), 421-425. doi: 10.1038/s41586-021-03647-4 (study analyzing bone marrow plasma cells of recovered COVID-19 patients reported durable evidence of antibodies for at least 11 months after infection, describing “robust antigen-specific, long-lived humoral immune response in humans”); Callaway, E. (2021, May 26). Had COVID? You'll probably make antibodies for a lifetime. *Nature*. [https://www.nature.com/articles/d41586-021-01442-](https://www.nature.com/articles/d41586-021-01442-9)

9#:~:text=Many%20people%20who%20have%20been,recovered%20from%20COVID%2D191 (“The study provides evidence that immunity triggered by SARS-CoV-2 infection will be extraordinarily long-

lasting” and “people who recover from mild COVID-19 have bone-marrow cells that can churn out antibodies for decades”).

^{xxiii} Ripperger, T. J., Uhrlaub, J. E., Watanabe, M., Wong, R., Castaneda, Y., Pizzato, H. A., Thompson, M. R., Bradshaw, C., Weinkauf, C. C., Bime, C., Erickson, H. L., Knox, K., Bixby, B., Parthasarathy, S., Chaudhary, S., Natt, B., Cristan, E., El Aini, T., Rischard, F., Bhattacharya, D. (2020). Orthogonal SARS-CoV-2 serological assays enable surveillance of low-prevalence communities and reveal durable humor immunity. *Immunity*, 53(5), 925-933. doi: 10.1016/j.immuni.2020.10.004 (study finding that spike and neutralizing antibodies remained detectable 5-7 months after recovering from infection).

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study finding that approximately 1/1000 of participants were reinfected); Bertollini, R., Chemaitelly, H., Yassine, H. M., Al-Thani, M. H., Al-Khal, A., & Abu-Raddad, L. J. (2021). Associations of vaccination and of prior infection with positive PCR test results for SARS-CoV-2 in airline passengers arriving in Qatar. *JAMA*, 326(2), 185-188. doi: 10.1001/jama.2021.9970 (study of international airline passengers arriving in Qatar found no statistically significant difference in risk of reinfection between those who had been vaccinated and those who had previously been infected); Pilz, S., Chakeri, A., Ioannidis, J. P. A., Richter, L., Theiler-Schwetz, V., Trummer, C., Krause, R., Allerberger, F. (2021). SARS-CoV-2 re-infection risk in Austria. *European Journal of Clinical Investigation*, 51(4), 1-7. doi: 10.1111/eci.13520 (previous SARS-CoV-2 infection reduced the odds of re-infection by 91% compared to first infection in the remaining general population); Breathnach, A. S., Duncan, C. J. A., El Bouzidi, K., Hanrath, A. T., Payne, B. A. I., Randell, P. A., Habibi, M. S., Riley, P. A., Planche, T. D., Busby, J. S., Sudhanva, M., Pallett, S. J. C. & Kelleher, W. P. (2021). Prior COVID-19 protects against reinfection, even in the absence of detectable antibodies. *The Journal of Infection*, 83(2), 237-279. doi: 10.1016/j.jinf.2021.05.024 (0.86% of previously infected population in London became reinfected); Tarke, A., Sidney, J., Methot, N., Yu, E. D., Zhang, Y., Dan, J. M., Goodwin, B., Rubiro, P., Sutherland, A., Wang, E., Frazier, A., Ramirez, S. I., Rawlings, S. A., Smith, D. M., da Silva Antunes, R., Peters, B., Scheuermann, R. H., Weiskopf, D., Crotty, S., Grifoni, A. & Sette, A. (2021). Impact of SARS-CoV-2 variants on the total CD4⁺ and CD8⁺ T cell reactivity in infected or vaccinated individuals, *Cell Reports Medicine* 2(7), 100355 (an examination of the comparative efficacy of T cell responses to existing variants from patients with natural immunity compared to those who received an mRNA vaccine found that the T cell responses of both recovered COVID patients and vaccines were effective at neutralizing mutations found in SARS-CoV-2 variants).

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